

GODDARD GRANT

IN-46

63922 CR
P-5

WILSON CYCLE STUDIES

NASA GRANT NAG5-585

Semi-Annual Report

January 15, 1986 to July 15, 1986

(Delayed inadvertently because of an overlooked typographical error in the previous report which read July 15, 1986 - where it should have read July 15, 1985)

The main activity relating to the study during this half year was a three week field trip to study Chinese sedimentary basins (June 10 to July 3, 1986) at no cost to the project. This study, while of a reconnaissance character, permitted progress in understanding how the processes of island arc-collision and micro-continental collision operated during the Paleozoic in far western China (especially the Junggar and Tarim basins and in the intervening Tien Shan Mountains). The effects of the continuing collision of India and Asia on the area were also studied. Most specifically, these result in the elevation of the Tien Shan to more than 4 km above sea level and the depression of Turfan to move 150m below sea level. Both thrusting and large-scale strike-slip motion are important in producing these elevation changes.

Some effort during the half year was also devoted to the study of greenstone-belts in terms of the Wilson Cycle and an abstract was contributed to an LPI workshop on greenstone-belts (Appendix 1 attached).

Kevin Burke
April 10, 1987

(NASA-CR-180247) WILSON CYCLE STUDIES
Semiannual Report, 15 Jan. - 15 Jul. 1986
(Ecuston Univ.) 5 p CSCL 08G

N87-19823

Unclas
G3/46 43654

WORKSHOP ON
TECTONIC EVOLUTION OF GREENSTONE BELTS

Edited by
M. J. deWit
and
Lewis D. Ashwal

Sponsored by
The Lunar and Planetary Institute
A Lunar and Planetary Institute Workshop
January 16-18, 1986

Lunar and Planetary Institute 3303 NASA Road 1 Houston, Texas 77058-4399

LPI Technical Report 86-10

GREENSTONE BELTS ARE NOT INTRACONTINENTAL RIFTS. WHAT THEN ARE THEY?
 Kevin Burke, Lunar and Planetary Institute, 3303 NASA Road One, Houston, Texas 77058 and Geosciences, University of Houston, University Park. Celal Sengor also Lunar and Planetary Institute, and Maden Fakultesi, ITU, Istanbul.

Hundreds of intracontinental rifts ("elongate depressions [within continents] overlying places where the lithosphere has ruptured in extension" ref. 1) with ages between 3.0 and 0 Ga have been recognized on earth (2,3,4). Compressional features are either absent or insignificant in the vast majority of these rifts. Prominent compressional features are reported from only a very few rifts. (Notably: the Benue trough (5) the Dneipr-Donetz rift (Fig. 1) (6) the Southern Oklahoma rift (7) and the rift occupying East Arm of Great Slave Lake (8)).

Intense compression is the rule in greenstone belts and preservation of regional extensional structures is rare. (Abstracts at this meeting). Whatever greenstone belts are they do not satisfy the definition of intracontinental rifts.

Wilson (9) showed that a common fate of intracontinental rifts is to develop into oceans and that oceans are likely to close. Mountain belts mark places where oceans have closed. In contrast to intracontinental rifts both mountain belts and greenstone belts are dominated by compressional structures. Pursuing Wilson's idea I therefore suggest that it might be useful for students of greenstone belts to test the hypothesis that: "Greenstone belts are mountain-belts marking places where OCEANS have closed". Ocean closing is a complicated process (ref. 1) and some of the regional complexities that may be recorded in greenstone belts are indicated in Fig. 2.

There is a possibility that students of greenstone belts are confusing each other because some who describe greenstone belts as intracontinental rifts may be consciously concentrating on an early episode in greenstone belt evolution and recognize that the belts have a later oceanic and collisional history. I suggest that this practise is confusing and is rather like describing Ronald Reagan as a movie actor and ignoring more significant later episodes in his career.

References

1. Basaltic Volcanism Study Project (1981). Basaltic Volcanism on the Terrestrial Planets. Pergamon Press, Inc., New York, 1286 pp.
2. Morgan, P. and Baker, B.M. (1983). Processes of continental rifting. Tectonophysics, 94, 680 pp.
3. Burke, K., Kidd, W.S.F. and Kusky, T.M. (1985). The Pongola structure of south-eastern Africa: The World's oldest preserved rift? Journ. of Geodynamics, 2, 35-49.
4. Burke, K., Delano, L., Dewey, J.F., Edelstein, A., Kidd, W.S.F., Nelson, K.D., Sengor, A.M.C. and Stroup, J. (1978). Rifts and sutures of the World. Contract Report NAS5-24094. Geophysics Branch, ESA Division, Goddard Space Flight Center, Greenbelt, Maryland. 238 pp.
5. Benkhelil, J., Dainelli, P., Ponsard, J.F., Popoff, M. and Saugy, L. (1986) The Benue trough in press AAPG special publication Sediments in Rifts ed. Warren Manspeizer.

GREENSTONE BELTS ARE NOT INTRACONTINENTAL RIFTS
Burke, K. and Sengor, C.

6. Sengor, A.M.C. (1985). Die Alpiden und die Kimmeriden: Die verdoppelte Geschichte der Tethys. Geol. Rundsh., 74, 181-213 pp.
7. Ham, W.E., Denison, R.E. and Merritt, C.A. (1964). Basement rocks and structural evolution of Southern Oklahoma. Oklahoma Geol. Surv. Bull., 95, 302pp.
8. Hoffman, P.E. (1980). Wopmay Orogen: a Wilson cycle of early Proterozoic age in the northwest of the Canadian Shield. In The Continental Crust of the Earth and its Mineral Deposits (D.W. Strangway, ed.). p.523-549. Geol. Assoc. Canada Spec. Paper 20, Toronto, Ontario.
9. Wilson, J.T. (1968). Static or Mobile Earth: the current scientific revolution. In Gondwanaland Revisited, p.309-320. Amer. Philos. Soc. Proc. vol. 112.

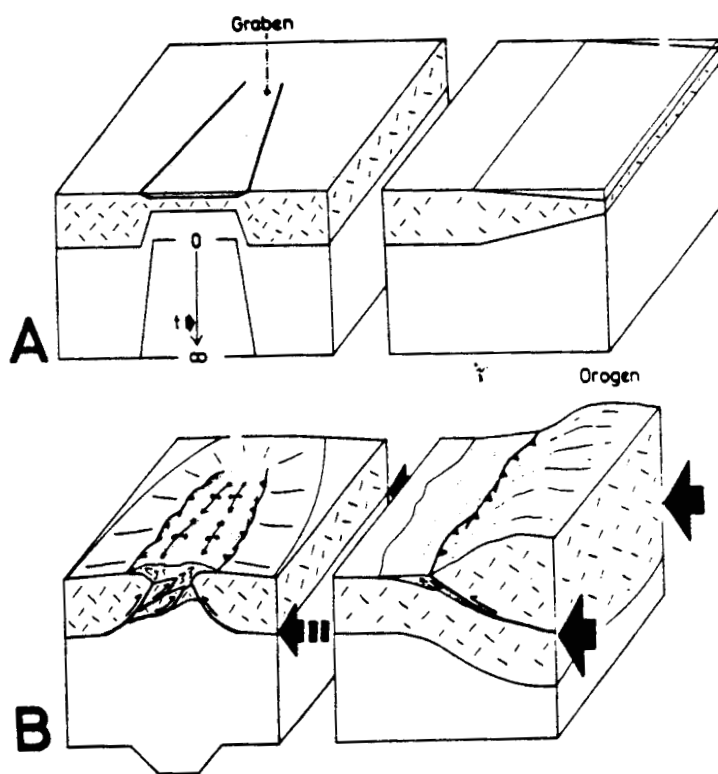


Figure 1. (from ref. 6) Illustration of how rifts within a continent (such as the Dneipr-Donetz rift) have been affected by neighboring continental collisions (as the Dneipr-Donetz structure responded to collisions in North Dobrudja in the Early Jurassic). Observation has shown that folding and thrusting developed in this environment is much less intense than that with which we are becoming familiar in greenstone belts.

GREENSTONE BELTS ARE NOT INTRACONTINENTAL RIFTS
 Burke, K. and Sengor, C.

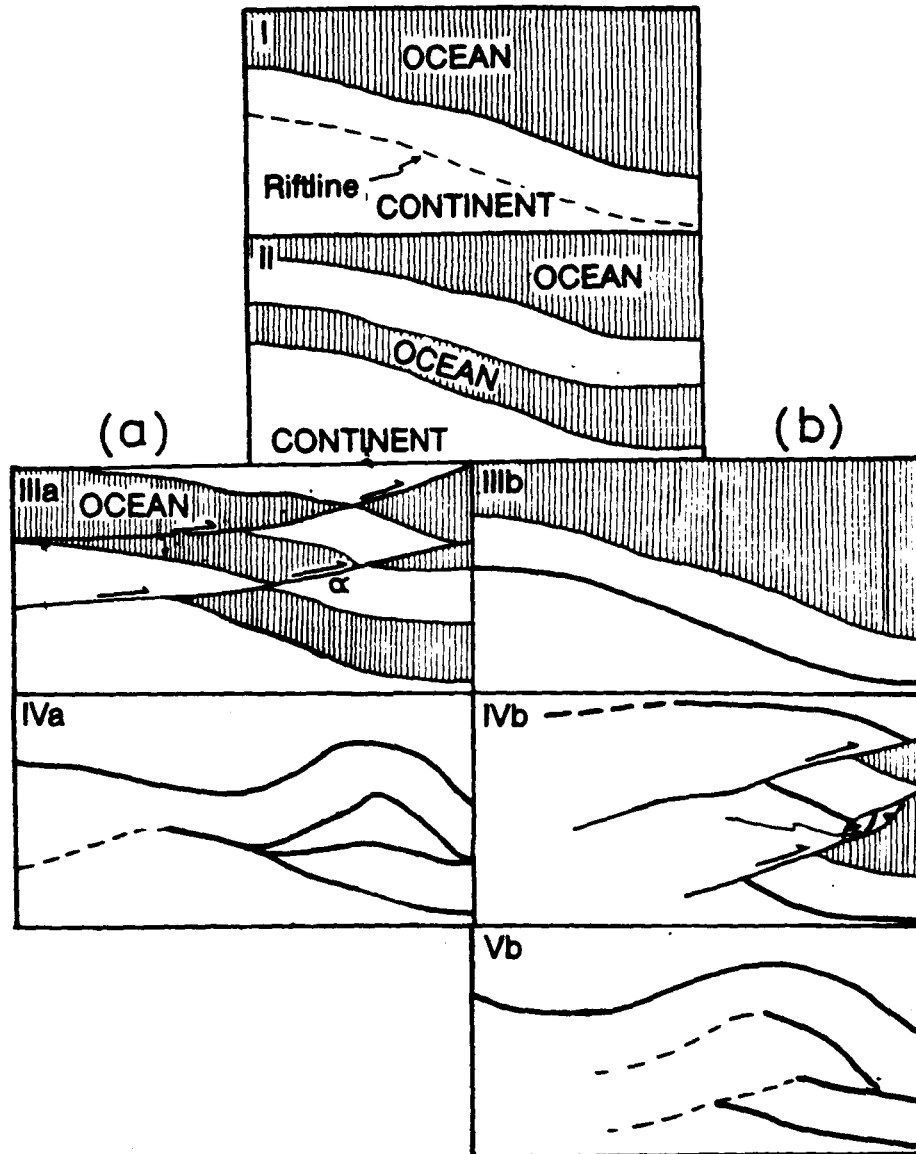


Figure 2. (from ref. 6) A possible origin for some greenstone belts. Rifting (I) takes a continental fragment out into an ocean (II). Major strike-slip motion (IIIa) is depicted as preceding collision between slivers of the continental fragment and the main continent (IVa). As an alternative suturing may take place (IIIb) before major strike-slip motion (IVb). In either case the preserved suture zones may end abruptly at strike-slip faults and late rotation may preserve puzzling polarities (Vb).